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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/537,611

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EXAMINER

KIM, JAY C

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/537,611	Applicant(s) KURAMOTO ET AL.	
	Examiner JAY C. KIM	Art Unit 2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 April 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4,6-9 and 11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4,6-9 and 11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 03 June 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

1. Claim 6 is objected to because of the following informalities: at the end of line 4, "group III nitride" should be inserted after "the". Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-4, 6-9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tadatomo et al. (US 6,225,650) in view of Motoki et al. (US 2003/0145783).

Regarding claim 1, Tadatomo et al. disclose a nitride semiconductor substrate (Fig. 4) comprising a base substrate (1) (col. 5, line 25 and col. 4, lines 12-15), a mask (2) (col. 5, line 22) formed over the base substrate (1), a group III nitride semiconductor multilayer film (composite layer of 3 and 31) (col. 5, lines 25-26 and 30) formed above the mask (2), wherein the mask (2) is made of non-crystalline material including nitrides (col. 4, lines 27-34) and may be formed into a multilayer structure (col. 4, lines 34-35).

Tadatomo et al. further disclose that a GaN crystal (1 in Figs. 9(a) and 10(a)) (col. 8, lines 57-58) can be a group III nitride semiconductor substrate for growing GaN crystal (3).

Tadatomo et al. differ from the claimed invention by not showing that the group III nitride semiconductor substrate has a dislocation density in the vicinity of the surface thereof of $1 \times 10^7/\text{cm}^2$ or less, and the mask has a polycrystalline material deposited on the surface thereof.

Motoki et al. disclose a group III nitride semiconductor substrate (Fig. 10(5)) formed by GaN single crystal growth (Fig. 10(4)) followed by polishing (line 1 of [0312]), which has a dislocation density in the vicinity of the surface thereof less than $1 \times 10^7/\text{cm}^2$ (lines 7-8 of [0316]). Motoki et al. further disclose a nitride semiconductor substrate (Fig. 5) where a mask (23) (SiO_2 on line 1 of [0183]) can have a polycrystalline material (polycrystalline GaN, line 2 of [0183]) deposited on the surface thereof.

Since both Tadatomo et al. and Motoki et al. teach a nitride semiconductor substrate, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to combine the nitride semiconductor substrate disclosed by Tadatomo et al. with the low dislocation density group III nitride semiconductor substrate and the mask having a polycrystalline material deposited on the surface thereof disclosed by Motoki et al., because the combined nitride semiconductor substrate could be used for improving device characteristics due to low dislocation density of the substrate, and a multilayer mask structure for GaN crystal growth is well-known and the polycrystalline material could be used for improving GaN growth. Furthermore, it has been held that simple substitution of one known element for another to obtain predictable results, and choosing from a finite number of identified, predictable

solutions, with a reasonable expectation of success would be obvious. KSR International Co. v. Teleflex Inc. 82 USPQ 2d 1385 (2007).

Regarding claim 2, Tadatomo et al. in view of Motoki et al. differ from the claimed invention by not showing that the polycrystalline material is formed from a material containing aluminum and nitrogen as essential elements.

Motoki et al. further disclose that the mask (23) can be made of polycrystalline aluminum nitride (AlN) or polycrystalline gallium nitride (GaN) ([0182]).

Since Motoki et al. teach a nitride semiconductor substrate, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to replace the polycrystalline GaN deposited on the mask disclosed by Tadatomo et al. in view of Motoki et al. with the polycrystalline AlN disclosed by Motoki et al., because both polycrystalline AlN and polycrystalline GaN can be used to grow high quality single crystal GaN. Furthermore, it has been held that simple substitution of one known element for another to obtain predictable results would be obvious. KSR International Co. v. Teleflex Inc. 82 USPQ 2d 1385 (2007).

Regarding claim 3, Tadatomo et al. in view of Motoki et al. differ from the claimed invention by not showing that voids are formed on the surface of the mask having the polycrystalline material.

Motoki et al. further disclose that voids (voluminous defects in voluminous defect accumulating region H in Fig. 5(a)(3)) are formed on the surface of the mask (23) having the polycrystalline material (lines 7-9 of [0299], lines 1-3 of [0420] and lines 11-13 of [0427]).

Since Motoki et al. teach a nitride semiconductor substrate, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to combine the nitride semiconductor substrate disclosed by Tadatomo et al. in view of Motoki et al. with voids formed on the surface of the mask having the polycrystalline material disclosed by Motoki et al., because voids would be formed on a mask while growing single crystal GaN due to imperfect growth of single crystal GaN on an amorphous or polycrystalline material.

Regarding claim 4, Tadatomo et al. further disclose for the nitride semiconductor substrate according to Claim 1 that the mask (2) is provided on the surface of the group III nitride semiconductor substrate (1).

Regarding claim 6, Tadatomo et al. disclose a nitride semiconductor device (Figs. 9(a), 9(b) and 10(a)) comprising a group III nitride semiconductor substrate (1) (col. 8, lines 57-58), a mask (2) (col. 4, line 8) formed over the group III nitride semiconductor substrate (1), and a group III nitride semiconductor multilayer film (composite layer of 3 and k or k1) (col. 4, line 9, col. 10, lines 6-10 and col. 8, lines 56-60) formed above the mask (2), the semiconductor multilayer film (composite layer of 3 and k or k1) including an active layer (k or k1), wherein the mask (2) is made of non-crystalline material including nitrides (col. 4, lines 27-34) and may be formed into a multilayer structure (col. 4, lines 34-35).

Tadatomo et al. differ from the claimed invention by not showing that the group III nitride semiconductor substrate has a dislocation density in the vicinity of the surface

thereof of $1 \times 10^7/\text{cm}^2$ or less, and the mask has a polycrystalline material deposited on the surface thereof.

Motoki et al. disclose a group III nitride semiconductor substrate (Fig. 10(5)) formed by GaN single crystal growth (Fig. 10(4)) followed by polishing (line 1 of [0312]), which has a dislocation density in the vicinity of the surface thereof less than $1 \times 10^7/\text{cm}^2$ (lines 7-8 of [0316]). Motoki et al. further disclose a nitride semiconductor substrate (Fig. 5) where a mask (23) (SiO_2 on line 1 of [0183]) has a polycrystalline material (polycrystalline GaN on line 2 of [0183]) deposited on the surface thereof.

Since both Tadatomo et al. and Motoki et al. teach a nitride semiconductor substrate, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to combine the nitride semiconductor device disclosed by Tadatomo et al. with the low dislocation density group III nitride semiconductor substrate and the mask having a polycrystalline material deposited on the surface thereof disclosed by Motoki et al., because the combined nitride semiconductor device would have improved device characteristics due to low dislocation density of the substrate, and a multilayer mask structure for GaN crystal growth is well-known and the polycrystalline material could be used for improving GaN growth. Furthermore, it has been held that simple substitution of one known element for another to obtain predictable results, and choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success would be obvious. *KSR International Co. v. Teleflex Inc.* 82 USPQ 2d 1385 (2007).

Regarding claim 7, Tadatomo et al. in view of Motoki et al. differ from the claimed invention by not showing that the polycrystalline material is formed from a material containing aluminum and nitrogen as essential elements.

Motoki et al. further disclose that the mask (23) can be made of polycrystalline aluminum nitride (AlN) or polycrystalline gallium nitride (GaN) ([0182]).

Since Motoki et al. teach a nitride semiconductor substrate, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to replace the polycrystalline GaN deposited on the mask disclosed by Tadatomo et al. in view of Motoki et al. with the polycrystalline AlN disclosed by Motoki et al., because both polycrystalline AlN and polycrystalline GaN can be used to grow high quality single crystal GaN. Furthermore, it has been held that simple substitution of one known element for another to obtain predictable results would be obvious. *KSR International Co. v. Teleflex Inc.* 82 USPQ 2d 1385 (2007).

Regarding claim 8, Tadatomo et al. in view of Motoki et al. differ from the claimed invention by not showing that voids are formed on the surface of the mask having the polycrystalline material.

Motoki et al. further disclose voids (voluminous defects in voluminous defect accumulating region H in Fig. 5(a)(3)) are formed on the surface of the mask (23) having the polycrystalline material (lines 7-9 of [0299], lines 1-3 of [0420] and lines 11-13 of [0427]).

Since Motoki et al. teach a nitride semiconductor substrate, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to

combine the nitride semiconductor device disclosed by Tadatomo et al. in view of Motoki et al. with voids formed on the surface of the mask having the polycrystalline material disclosed by Motoki et al., because voids would be formed on a mask while growing single crystal GaN due to imperfect growth of single crystal GaN on an amorphous or polycrystalline material.

Regarding claim 9, Tadatomo et al. further disclose for the nitride semiconductor device according to Claim 6 that the mask (2) is provided on the surface of the group III nitride semiconductor substrate (1).

Regarding claim 11, Tadatomo et al. in view of Motoki et al. differ from the claimed invention by not showing that the mask is provided in the vicinity of a device separating groove of the nitride semiconductor device.

Tadatomo et al. further disclose that a mask (2 in Fig. 11) is provided in the vicinity of a device separating groove (groove separating the devices in Fig. 11) (col. 10, lines 24-26) of the nitride semiconductor device (Fig. 11).

Since Tadatomo et al. teach a nitride semiconductor device, it would have been obvious to the one of ordinary skill in the art at the time the invention was made to combine the nitride semiconductor device disclosed by Tadatomo et al. in view of Motoki et al. with the device separating groove disclosed by Tadatomo et al., because forming a stripe laser comprising a device separating groove is well-known in manufacturing a nitride semiconductor device as well as forming an individual nitride semiconductor device shown in Fig. 9(b) of Tadatomo et al. Furthermore, it has been held that combining prior art elements according to known methods to yield predictable

results would be obvious. KSR International Co. v. Teleflex Inc. 82 USPQ 2d 1385 (2007).

Response to Arguments

4. Applicants' arguments filed April 21, 2008 have been fully considered but they are not persuasive.

Applicants argue that “although the dislocation densities of the Samples M and N are lower than that of the Sample J, the mask materials of these samples are different, and therefore, they are not comparable”, and that “it is not clear from the disclosure of Motoki et al whether the presence of the polycrystalline material on the mask film has effects on the dislocation density”. The low dislocation density GaN substrate shown in Fig. 10(5) of Motoki et al. is used to replace the GaN substrate (1) shown in Figs. 4 and 9(a) of Tadatomo et al., and the mask structure (23) shown in Fig. 5 of Motoki et al. is used to replace the mask (2) shown in Figs. 4 and 9(a) of Tadatomo et al., and therefore Applicants' argument regarding relation between the presence of the polycrystalline material and the dislocation density is irrelevant to the above rejections, because Applicants do not claim dislocation density in the group III nitride semiconductor multilayer film.

Applicants argue that “Applicants have advised that it was generally believed at the time the present invention was made, that polycrystalline materials on the mask may cause undesirable influences with respect to the states of the grown GaN”. However, as Applicants summarized in pages 6 and 7 of REMARKS, Motoki et al. had already

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discovered that a polycrystalline material on a mask can work in a similar manner to other well-known mask materials when it comes to the quality of the grown GaN crystal.

Applicants argue that “it would not have been obvious to those skilled in the art that a nitride semiconductor substrate comprising a low dislocation density, and multilayer mask structure including a polycrystalline material, may be employed to improve device characteristics”. As stated in the above rejections, Tadamoto et al. in view of Motoki et al. disclose all the limitations of the claims.

Applicants argue that “Tadamoto et al does not teach or suggest that a Group III nitride semiconductor substrate is used for growth of the Group III nitride such as GaN crystal”. Tadamoto et al. further disclose that a GaN crystal (1 in Figs. 9(a) and 10(a)) (col. 8, lines 57-58) can be a group III nitride semiconductor substrate for growing GaN crystal (3).

Applicants argue that “in Motoki et al, GaN crystals are grown on an undersubstrate 41, wherein the material of the undersubstrate is sapphire (Embodiment 1), GaAs (Embodiments 2 and 3), as well as O and P (Embodiment 4)”, and that “Motoki et al does not teach or suggest that a Group III nitride crystal is grown on a Group III nitride substrate”. The low dislocation density GaN substrate in Fig. 10(5) of Motoki et al. is used to replace the GaN substrate disclosed by Tadamoto et al., and a group III nitride crystal grown on a group III nitride substrate is disclosed in Tadamoto et al.

Applicants argue that “it is not clear from the disclosure of Motoki et al whether the presence of the polycrystalline material on the mask film has effects on the dislocation density”. The low dislocation density GaN substrate shown in Fig. 10(5) of

Motoki et al. is used to replace the GaN substrate (1) shown in Figs. 4 and 9(a) of Tadatomo et al., and the mask structure (23) shown in Fig. 5 of Motoki et al. is used to replace the mask (2) shown in Figs. 4 and 9(a) of Tadatomo et al., and therefore Applicants' argument regarding relation between the presence of the polycrystalline material and the dislocation density is irrelevant to the above rejections, because Applicants do not claim dislocation density in the group III nitride semiconductor multilayer film.

Applicants argue that "according to the presently claimed invention, the above problems are solved by using a polycrystalline material deposited on the surface of the mask", and that "since the inventions of Motoki et al and Tadamoto et al are different from the present invention in premise, the present invention would not have been obvious over Motoki et al and Tadamoto et al". Applicants do not claim the problems to be solved, and it has been held that it is not necessary that the prior art suggest the combination to achieve the same advantage or result discovered by applicant. See, e.g., *In re Kahn*, 441 F.3d 977, 987, 78 USPQ 2d 1329, 1336 (Fed. Cir. 2006).

Applicants argue that "the significant effects of the present invention are shown in Examples 1-6 of the present specification". Applicants do not claim the significant effects of the present invention.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JAY C. KIM whose telephone number is (571)270-1620. The examiner can normally be reached on 7:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Matthew C. Landau/
Primary Examiner, Art Unit 2815

/J. K./
Examiner, Art Unit 2815

May 9, 2008